What is claimed is:

1. A semiconductor optical device comprising:

a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and

a reflecting multi-layer film formed on at least one of a pair of opposing end faces of the waveguide layer,

wherein a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive index n_i and film thickness d_i of a layer denoted with i-th the reflecting multi-layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a relationship:

$$\Sigma n_i d_i > \lambda_0/4,$$

wherein a first wavelength bandwidth $\Delta\lambda$ is wider than a second wavelength bandwidth $\Delta\Lambda$, the first wavelength bandwidth $\Delta\lambda$ being a wavelength range including the wavelength λ_0 in which a reflectance R of the reflecting multi-layer film is not higher than +2.0% from reflectance R at the wavelength λ_0, the second wavelength bandwidth $\Delta\Lambda$ being a wavelength range including the wavelength λ_0 in which a reflectance R' of a hypothetical layer is not higher than +2.0% from reflectance R' at the wavelength λ_0 of a hypothetical layer having a thickness of $5\lambda_0/(4n_f)$ of a refractive index n_f formed on the at least one of opposing end faces satisfies a relationship:

$$R' = ((n_c - n_f^2)/(n_c + n_f^2))^2,$$

wherein the n_c denotes an effective refractive index of the waveguide layer.

2. A semiconductor optical device comprising:

a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and

a reflecting multi-layer film formed on at least one of a pair of opposing end faces of the waveguide layer,

wherein a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive index n_i and film thickness d_i of a layer denoted with i in the reflecting multi-layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a relationship:

$\Sigma n_i d_i > \lambda_0/4$,

wherein a ratio $\Delta\lambda/\lambda_0$ is not lower than 0.062, the reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.0% to +2.0% of the reflectance R at the wavelength λ_0.

3. A semiconductor optical device comprising:

a waveguide layer including two cladding layers and an active layer sandwiched between the two cladding layers; and

a reflecting multi-layer film formed on at least one of a pair of opposing end faces of the waveguide layer,

wherein a summation $\Sigma n_i d_i$ of products $n_i d_i$ of refractive index n_i and film thickness d_i of a layer denoted with i in the reflecting multi-layer film, and a wavelength λ_0 of light guided through the waveguide layer satisfies a relationship:

$\Sigma n_i d_i > \lambda_0/4$,

wherein a ratio $\Delta\lambda/\lambda_0$ is not lower than 0.066, the reflectance R in the bandwidth $\Delta\lambda$ ranges from -1.5% to +1.0% of the reflectance R at the wavelength λ_0.

4. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes a first film having a refractive index larger

than a square root of an effective refractive index n_c of the waveguide layer and a second film having a refractive index smaller than the square root of the effective refractive index n_c.

5. A semiconductor optical device according to claim 4, wherein the first reflecting film and the second reflecting film are layered alternately.

6. A semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film, which is in contact with the waveguide layer has a refractive index smaller than a square root of an effective refractive index n_c of the waveguide layer.

7. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes at least three layers made of material different from each other.

8. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes seven films.

9. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes six films.

10. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes nine films.

11. A semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film in contact with the waveguide layer has the highest heat conductivity in the films in the reflecting multi-layer film.

12. A semiconductor optical device according to claim 1, wherein a first-layer film of the reflecting multi-layer film is in contact with the waveguide layer made of aluminum nitride.

13. A semiconductor optical device according to claim 1, wherein a minimal

value of the reflectance of the reflecting multi-layer film is within range from 1% to 32%.

14. A semiconductor optical device according to claim 1, wherein first-layer film, which is in contact with the waveguide layer, and second-layer film of the reflecting multi-layer film have a refractive index smaller than a square root of an effective refractive index n_c of the waveguide layer.

15. A semiconductor optical device according to claim 1, wherein the reflecting multi-layer film includes eight films.